# INSTRUCTION MANUAL

# MODEL 512

## TRANSISTOR NOISE TEST SET

for Serial No. 150

QT

• ELECTRONIC INSTRUMENTS

Quan-Tech

LABORATORIES INC.

WHIPPANY, N. J.

C. TOWNSEND
x968

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# MODEL 512

## TRANSISTOR NOISE TEST SET

for Serial No. 150

Quan-Tech LABORATORIES

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

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## CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

## WARRANTY

Quan-Tech Laboratories, Inc. warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Electronic tubes and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misadjustments, misuse, or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

Calibration checks of this instrument can easily be made in accordance with the instruction manual. Routine readjustments should never be attempted. If, however, the instrument has been damaged and requires recalibration or alignment, explicit calibration procedures as defined in the instruction manual must be followed.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number and serial number. On receipt of this information, we will give you service data or shipping instructions.

2. On receipt of shipping instructions, forward the instrument prepaid, to the factory. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

## SHIPPING

The instruments should be packed in their original containers, or in a strong exterior container and surrounded by two inches of shock absorbing material.

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## SECTION 1
## GENERAL

### A. DESCRIPTION

The Model 512 Transistor Noise Test Set is a compact, simplified unit designed to measure the noise figure of transistors over the frequency range of 10 cycles to 10 kilocycles. Voltage sensitive devices may be measured as well as conventional junction transistors, within the transconductance range of from 400 to 40,000 micromhos. The front panel meter readout is noise figure in db and is automatically calibrated for the internally available base resistances of 50, 500, 1000 and 10,000 ohms. A position of the BASE RESISTANCE switch and terminals on the test jig are provided for the insertion of base resistances other than the above. In the EXT. position of the BASE RESISTANCE switch the front panel noise meter will read noise voltage in db with one nanovolt per root cycle of white noise used as the zero db reference. Direct readout in db, automatic calibration and ease of operation make the Model 512 ideally suited to production and quality control applications.

### B. SPECIFICATIONS

| | |
|---|---|
| NOISE: | Noise figure measured directly in db for selected base resistances of 50, 500, 1000 and 10,000 ohms. |
| | Noise voltage measured in db with one nanovolt per root cycle of white noise used as the zero db reference in the EXT. position of the BASE RESISTANCE switch. |
| | All measurements made with an equivalent noise bandwidth of 15.7 Kc. The upper and lower 3 db frequencies are 10 kilocycles and 10 cycles respectively. |
| | Meter Readout: Zero to 12 db with meter multiplier switch extending range to 62 db in 10 db steps. |
| | Accuracy: ± 1 db. |
| COLLECTOR VOLTAGE: | ± 3 to 30 volts. |
| | Meter Ranges: 10 and 30 volts full scale. |
| | Meter Accuracy: ± 5% of full scale. |

B. SPECIFICATIONS (Cont'd)

| | |
|---|---|
| COLLECTOR CURRENT: | Range: 10 to 1000 microamperes. |
| | Meter Ranges: 30, 100, 300 and 1000 microamperes full scale. |
| | Meter Accuracy: ± 5% of full scale. |
| ANALOG OUTPUT: | 0 to + 1 volt, proportional to noise meter reading. |
| DIMENSIONS: | 12"Wx 6"Hx8"D, weight 12 lbs. |
| POWER INPUT: | 117/234 volts, 50-60 cycles, 6 watts. |

## SECTION 2
## OPERATION

A. FIRST TIME OPERATION

1. Connect the line plug of the instrument to a suitable source of power. (Check the voltage plate at the rear of the chassis for primary voltage). If the internal primary power connections must be changed, refer to SECTION 5 for instructions.

2. Turn the power switch to ON. Set the front panel voltage and current controls for the transistor type, collector voltage and collector current desired. Note that the meters for current and voltage always read the operating conditions which will exist if a functioning transistor is placed in the test jig and the jig interlock closed.

3. Insert the transistor to be tested in the test socket and close the jig cover.

4. Set the METER MULTIPLIER switch for an on-scale reading of the NOISE FIGURE meter. The NOISE FIGURE meter will now be indicating the noise figure of the transistor under test for the preset operating conditions and the base resistance indicated by the position of the BASE RESISTANCE switch.

✓ Note that in the EXT. position of the BASE RESISTANCE switch the front panel meter reads total noise in DB rather than NOISE FIGURE directly. In order to obtain noise figure when the BASE RESISTANCE switch is in the EXT. position, the thermal noise (in DB) of the base resistance must be subtracted from the total noise reading. Thermal noise in DB for a particular base resistance value is obtained by finding the thermal noise voltage on the chart given in Figure 2-2, then converting this to DB by using the chart given in Figure 2-1.

B. FRONT PANEL METERS AND CONTROLS

1. Noise Meter and Meter Multiplier

The NOISE FIGURE meter is automatically calibrated to read noise figure directly for all positions of the BASE RESISTANCE switch except EXT. The correct noise figure reading is always the sum of the METER MULTIPLIER position and the NOISE FIGURE meter indication.

In the EXT. position of the BASE RESISTANCE switch the panel meter is calibrated to read noise voltage referred to the base of the transistor under test using one nanovolt per root cycle of white noise as the zero db reference. As in the noise figure measurements the correct noise reading is always the sum of the METER MULTIPLIER and the panel meter indication.

B. FRONT PANEL METERS AND CONTROLS (Cont'd)

2. Ammeter, Current Range Switch and Current Adjust.

The front panel metering for collector current is an indicator of the current which will exist if a functioning transistor is placed in the test jig and the shield cover closed. Note that the panel meter is not actually monitoring the collector current and does indicate with a transistor in or out of the test socket and with the shield cover open or closed.

The complete current range of the instrument is obtainable through the use of the range switch and the smaller concentric control which gives a variation of from one third scale to full scale.

3. Voltmeter, Voltmeter Multiplier and Voltage Adjust.

The voltmeter range switch serves to select the polarity of the collector voltage (NPN-PNP) in addition to the full scale sensitivity of the panel meter. The smaller concentric control provides continuous adjustment of the collector voltage over the full range of from 3 to 30 volts.

NOTE:

For transistors having very low current gain or for operation at high values of collector current with high values of base resistance, the collector voltage may have to be set greater than three volts. A problem in this area usually shows up as erratic behavior of the NOISE meter. (Abnormally high or abnormally low reading).

4. Test Jig.

Two sockets for the transistor to be tested, a voltage interlock switch activated by the shield cover, binding posts for an external base resistor and a base resistance selector switch are located on the test jig. The very low measuring levels of this equipment require that the test sockets, test transistor and base resistors be shielded when a noise measurement is being made. The hinged cover accomplishes the required shielding and also activates the interlock switch which removes the base voltage for loading and unloading. This cover should therefore be closed when a noise measurement is being made.

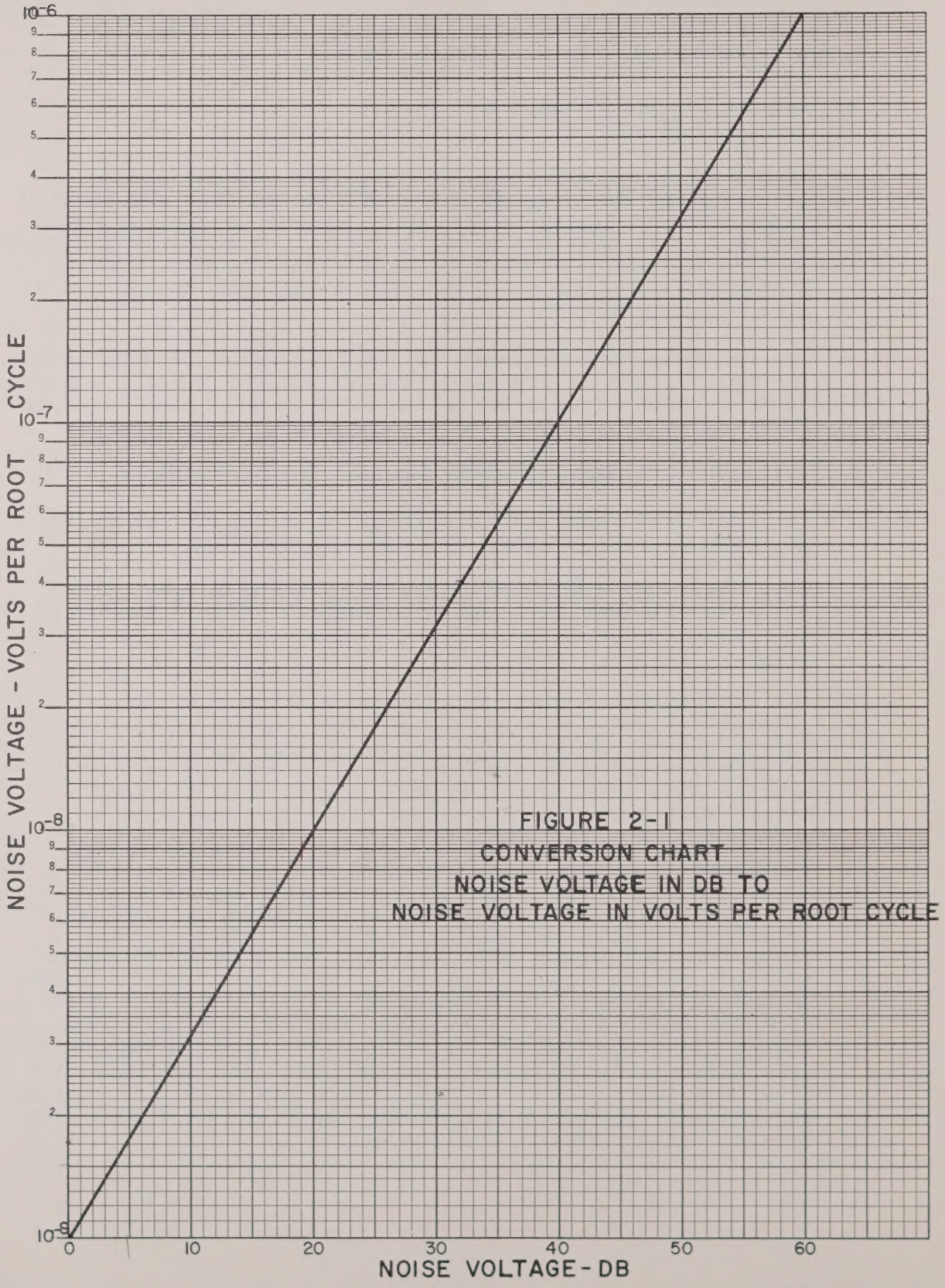



FIGURE 2-1
CONVERSION CHART
NOISE VOLTAGE IN DB TO
NOISE VOLTAGE IN VOLTS PER ROOT CYCLE

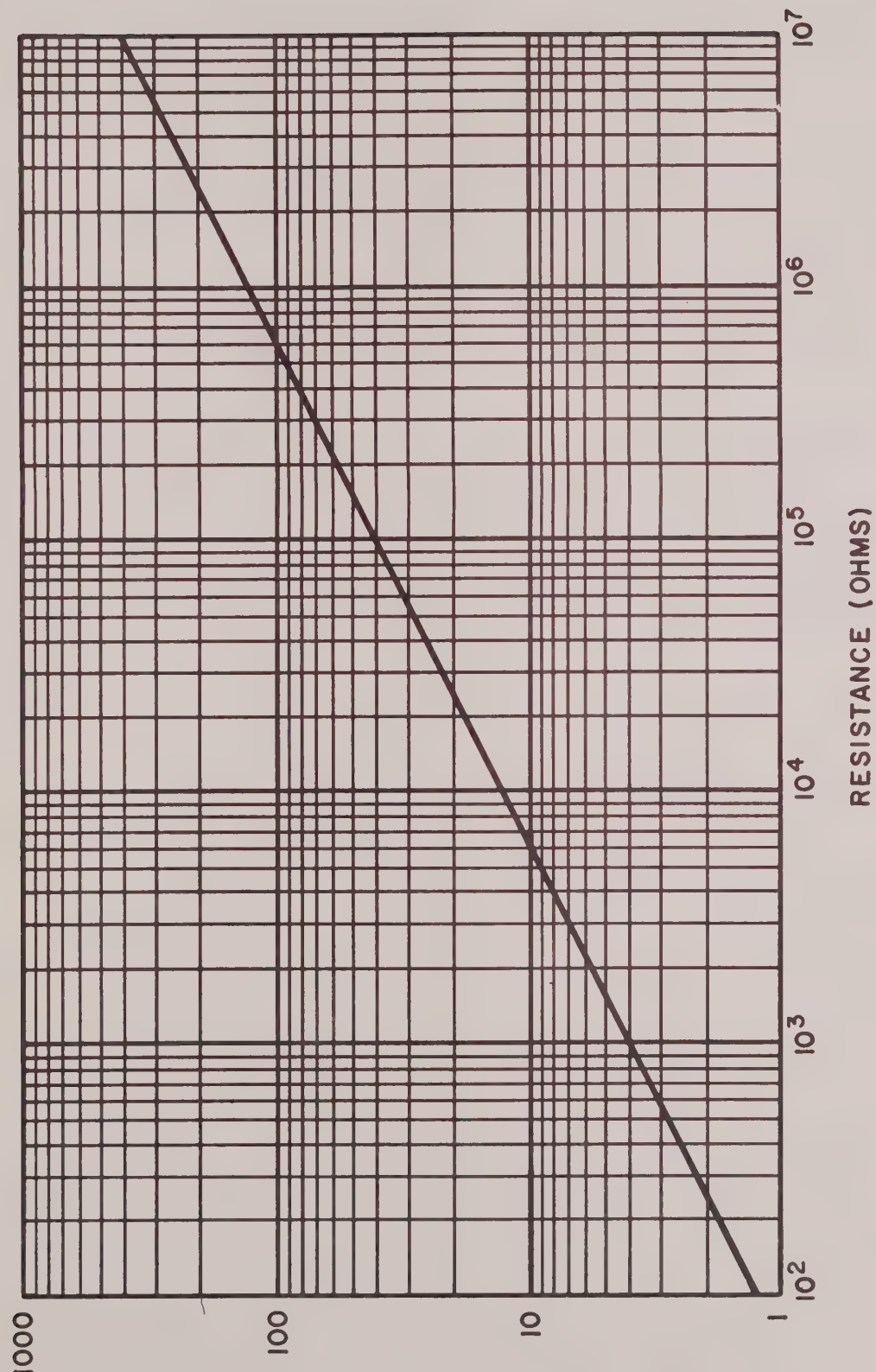



FIGURE 2-2
THERMAL NOISE VOLTAGE vs RESISTANCE

## SECTION 3

## THEORY OF OPERATION

### A. GENERAL

The basic method of calibration of this equipment is the known gain; known bandwidth method. Gain calibration is obtained by including the transistor under test in a feedback amplifier. (See Block Diagram). The transistor under test, the Pre-amplifier and Amplifier #2 are connected such that their gains multiply to drive a resistive feedback divider. The result is a constant voltage gain from the base of the transistor under test to the output of Amplifier #2.

The remainder of the noise channel is straightforward amplification and attenuation. One section of the attenuator is connected to the BASE RESISTANCE switch so that the overall gain is changed as required for each of the values of base resistance.

The bandpass filter has 6 db per octave skirts, 10 cycle and 10 kilocycle 3 db down points and a corresponding 15.7Kc equivalent noise bandwidth.

## A. GENERAL

The Block Diagram, T-4630, shows the basic connections between individual circuits. Reference to the diagram and the appropriate schematic diagram will enable the reader to follow the individual circuit descriptions.

## B. PRIMARY POWER AND BIAS SUPPLIES (Schematic T-4636)

The line connections, power switch and fuse are shown on this schematic. The multiple secondaries are labelled in accordance with their circuit association.

The +12 volt supply is a straightforward double differential, regulated power supply which is the main dc power source for the entire test set. In this supply the voltage difference between the zener diode, CR103 and the voltage at the junction point of R103 and R104 is detected and amplified by the double differential configuration of Q101, Q102, Q103 and Q104 and applied to the series regulator transistor Q105. The resulting action of Q105 serves to maintain a constant voltage at the output terminals of the supply independent of load.

The -6 volt supply is a light load, zener regulated supply which receives its unregulated dc from the collector of Q105 of the +12 volt supply.

## C. COLLECTOR CURRENT SUPPLY (Schematic T-4632)

The collector current supply is a regulated supply whose output voltage can be varied from 10 volts to 30 volts using the front panel current adjust control. The reference voltage for this supply is obtained through the use of a double zener circuit involving CR207, Q201 and CR208. Fixed resistor, R205, across the reference voltage generates a constant current through the voltage control R213. Q202 and Q203 serve as a two stage error amplifier which monitors the output voltage and drives the series regulator Q205 to maintain the desired regulated output voltage.

## D. COLLECTOR VOLTAGE SUPPLY (Schematic T-4633)

The operation of this supply is the same as that of the CURRENT supply and should require no further explanation.

## E. PREAMPLIFIER (Schematic C-4634)

The preamplifier provides the dc bias control for the transistor under test in addition to the obvious function of noise amplification. The four detector transistors Q401, Q402, Q403 and Q404 function two at a time; Q401 and Q404 apply in the NPN test

## CIRCUIT DESCRIPTION (Cont'd)

E. PREAMPLIFIER (Schematic C-4634) Cont'd

position and Q402 and Q403 function for the PNP position. The voltage between pins 9 and 10 is the control voltage that determines the collector current in the test transistor. For the NPN test (shown in the schematic) Q401, Q404 and Q405 are the functioning transistors which control the dc operating condition of the transistor under test.

The current gain of Q404 (or Q403 for PNP) is realized for noise amplification, the noise output of the preamplifier being taken across R416.

F. AMPL. #2, ATTN, AMPL. #3 AND FILTER (Schematic T-4635)

Amplifier #2 is a straightforward two stage amplifier utilizing negative feedback for gain stabilization, and an emitter follower for the noise output.

The output of Ampl. #2 is applied to the emitter of the transistor under test through R428. Application of negative feedback around the test transistor in this way provides a constant gain closed loop which is independent of the test transistor parameters.

The noise signal is also applied to the input of Amplifier #3 through emitter follower, Q507, the BASE RESISTANCE switch attenuator, R512 through R515, and the METER MULTIPLIER, R516 through R522.

Ampl. #3 is very much like Ampl. #2 except that it has the additional power gain stages Q505 and Q506 which are required to drive the bandpass filter, B-4614. Negative feedback is employed in Ampl. #3 also for gain stabilization.

The bandpass filter, B-4614, has an equivalent noise bandwidth of 15.7 Kc. This bandwidth is achieved through the use of 6 db per octave skirts and 3 db points of 10 cycles and 1[illegible] kilocycles.

G. AMPL. #4, METER AMPL. AND LOG CONVERTER (Schematic T-4636)

Ampl. #4 is identical in operation to Ampl. #3. The gain of this amplifier is adjusted with R606 to achieve overall gain calibration at zero DB meter indication. (Procedure is given in Section 5.)

Q605 and Q606 are the two active stages of the meter amplifier. The emitter of Q606 appears as a constant current source due to the negative feedback configuration. Q607 provides the required dc bias to Q606 without appearing as a shunt load across the metering circuit of CR603, CR604, C608, R629, R630 and meter M601.

Diode CR605 allows the resistive divider associated with R632 to shunt the metering circuit on the upper half of the meter scale providing a more nearly linear spacing of the db calibration marks. R634 determines the amount of compression on the upper end of the meter scale and is therefore used for the 10 DB calibration.

## A. GENERAL

The approach taken in the design of this equipment was to virtually eliminate preventive maintenance. All active and unidirectional components are solid state and have undergone a rigorous noise screening program to insure long life.

Precision value resistors have also been used in many areas to eliminate the need for periodic adjustment.

The only adjustments in this equipment are two noise calibration adjustments, one for each end of the NOISE FIGURE meter. It is recommended that the adjustments be changed only after it has been firmly established that it is required.

In the event that servicing is required and the instrument is removed from its case, the following precautions should be observed:

1. Turn main power off when connecting or disconnecting printed circuit assemblies to avoid transients.

2. Make voltage checks on the connector board using the voltage chart supplied, being careful not to short out adjacent copper in the process.

3. In soldering the printed circuit boards have the iron only hot enough to make a clean rapid joint and DO NOT apply any force which would tend to push the copper away from the board.

## B. REMOVAL OF THE CASE

Remove the four No.8 binder head screws from the rear of the case and gently slide the unit forward out of the case. It will be necessary to raise the handle during this process.

## C. CHANGING THE INPUT VOLTAGE

This instrument has been designed to operate from either a 117 volt or a 234 volt AC power source. The plate on the rear of the instrument near the power cord indicates the voltage at which the instrument should be operated. If the input voltage must be changed, the procedure given should be followed:

1. Remove the case.
2. Change the transformer primary connections by moving the jumpers on the 4 terminal barrier strip located on the bottom of the printed circuit module connector board. Connect the jumpers as indicated in Figure 5-1.
3. Reverse the plate on the rear of the instrument to indicate the new voltage connections.
4. Replace the instrument in the case.

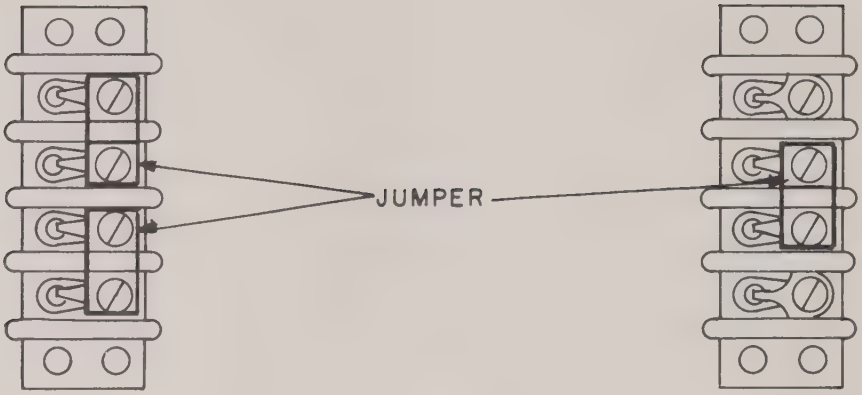



FIGURE 5-1. INPUT VOLTAGE BARRIER STRIP

D. DETAILED CALIBRATION

1. Positive 12 Volt Supply: This selection is normally made at the factory and should not require attention unless components have been changed on the circuit board.

    a. Select R105 for 12 volts dc between pins 8 and 9 of Ass'y 4625.

2. Input Noise Cal. Attenuator: Selection normally made at the factory and should not require attention again.

    a. Select R411 or R415 on Pre-Ampl. board to give 1000:1 attenuation from NOISE CAL jack, J401, to pin 7 of Pre-Ampl. board.

3. Noise Calibration:

The NOISE meter calibration may be accomplished in either of two ways. The simplest of the two is to apply a known magnitude of white noise voltage to the input of the measuring system and adjust the overall gain for the correct noise voltage reading on the panel meter. The following procedure utilizes a Quan-Tech Laboratories Model 420 Random Noise Generator.

    a. Set the Model 512 current range switch to the full clockwise position; the BASE RESISTANCE switch to the EXT. position; place a short circuit across the EXT. terminals on the test jig; place a transistor in the test socket and close the jig shield cover. Check to see that the voltmeter range -NPN-PNP switch is in the proper position for the transistor in the test socket.

    b. Set the METER MULTIPLIER switch on the Model 512 to the +40 position and connect the output of the Model 420 to the NOISE CAL jack at the rear of the Model 512.

    c. Set the Model 420 METER MULTIPLIER switch to the X100 position; the termination switch to the UNTERM position and the VARIABLE output control for 1.0 meter indication.

    d. Adjust R606, 0 DB CAL, located on the module connector board between the connectors for Assemblies 4610 and 4611 for 0 DB indication on the NOISE FIGURE meter.

        NOTE: Due to the basic nature of measuring a random noise signal the NOISE meter reading will in general exhibit variations with time, dependent upon the actual filter bandwidth and the metering time constant. This condition must be understood and accepted if calibration with

D. DETAILED CALIBRATION (Cont'd)

3. Noise Calibration (Cont'd):

d. (Cont'd)

a noise source is to be accomplished. There is a certain amount of "integration by eye" required when using this technique, however, experience has shown that satisfactory calibration is quite easily obtained.

e. Set the METER MULTIPLIER switch on the Model 512 to the +30 position. Adjust R634, located just behind the VOLTAGE meter on the side plate, for 10 DB indication on the NOISE FIGURE meter.

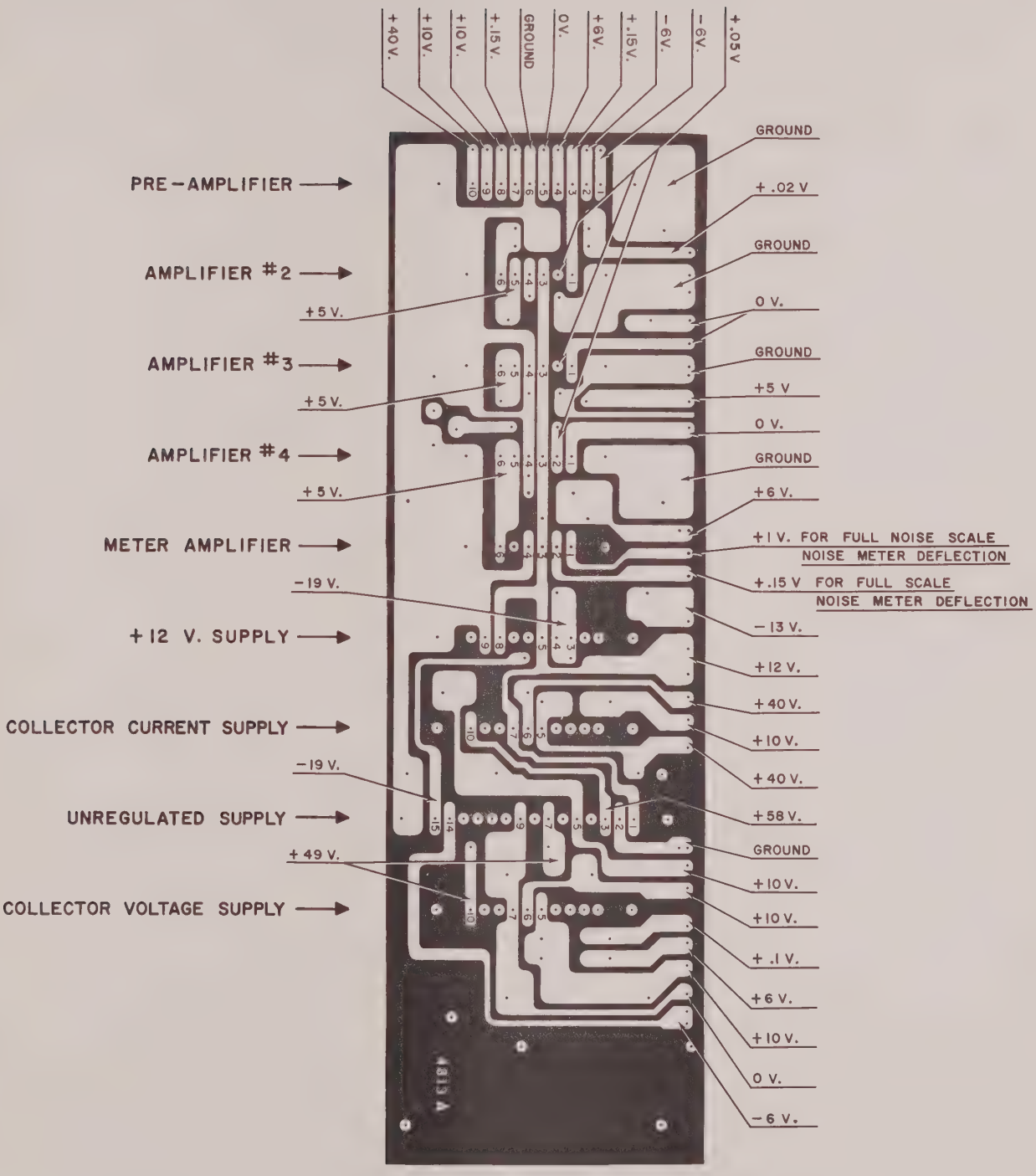
The second method of calibration is the known gain, known bandwidth method. This method involves measurement of the filter bandwidth, the application of correction factors for the averaging meter circuit and conversion to equivalent noise bandwidth for the particular filter design. The following equation may be used to obtain the RMS sine wave calibrating voltage:

$$e_{cal} = (\text{NOISE BW})^{\frac{1}{2}} (\text{SCALE READING}) (888) \text{ volts}$$

where (NOISE BW) is the equivalent noise bandwidth of the filter, (SCALE READING) is the actual level or reading at which calibration is to be checked and (888) is the product of the correction factor for the average meter and the input attenuator ratio.

The equivalent noise bandwidth for the single section filter is 1.57 times the 3 db bandwidth.

The above procedure provides the method for obtaining a sine wave signal which is to be applied to the NOISE CAL jack the same as in the first calibration instructions. All other directions from the first method should be followed also.



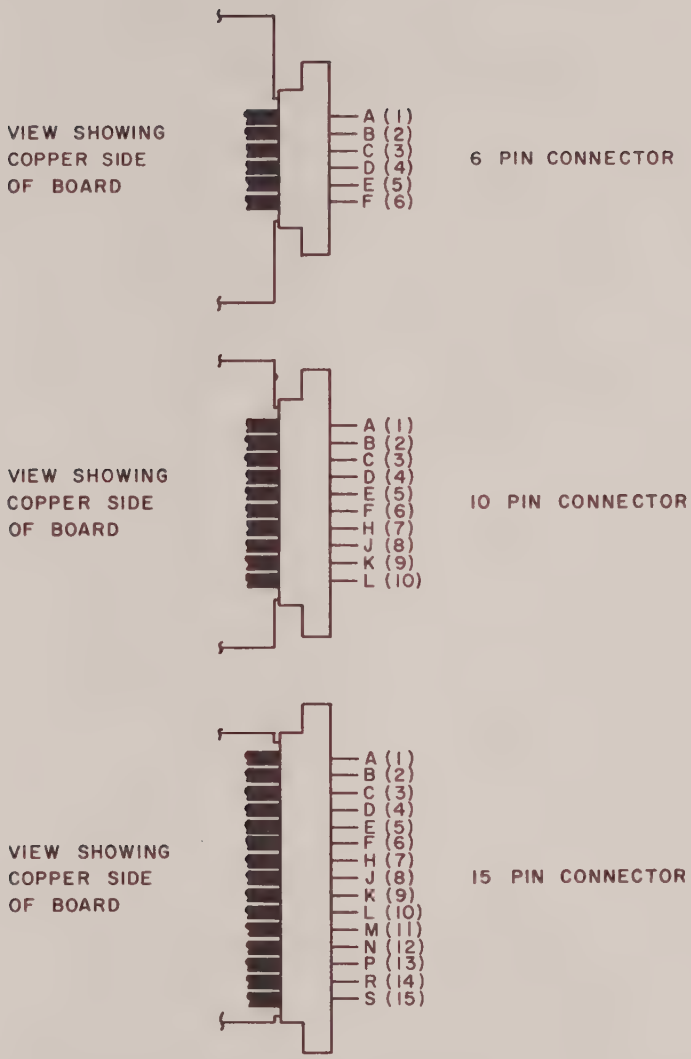

LINE VOLTAGE: 117 OR 234 VOLTS; GERMANIUM NPN TRANSISTOR IN TEST SOCKET AND COVER CLOSED; CURRENT RANGE-300 uA; CURRENT ADJUST-300 uA; VOLTAGE RANGE-10V, NPN; VOLTAGE ADJUST-10V; NOISE FULL SCALE-ON SCALE READING.

ALL VOLTAGES MEASURED TO GROUND WITH 20,000 OHM/VOLT D.C. VOLTMETER. A.C. VOLTAGES ARE GIVEN ON SCHEMATIC T-4631.

BOTTOM VIEW OF CONNECTOR BOARD

FIGURE 5-2

VOLTAGE CHART




PRINTED CIRCUIT BOARD CONNECTOR LUG IDENTIFICATION

## SCHEMATIC LEGEND

k = 1000

⊘ = Screw Driver Adjustment

▭ = Front Panel Control

* = Factory Select

Unless Otherwise Specified:

All Resistances in Ohms

All Resistors 1/2 Watt

All Capacitances in Microfarads

# SEMICONDUCTOR LEGEND

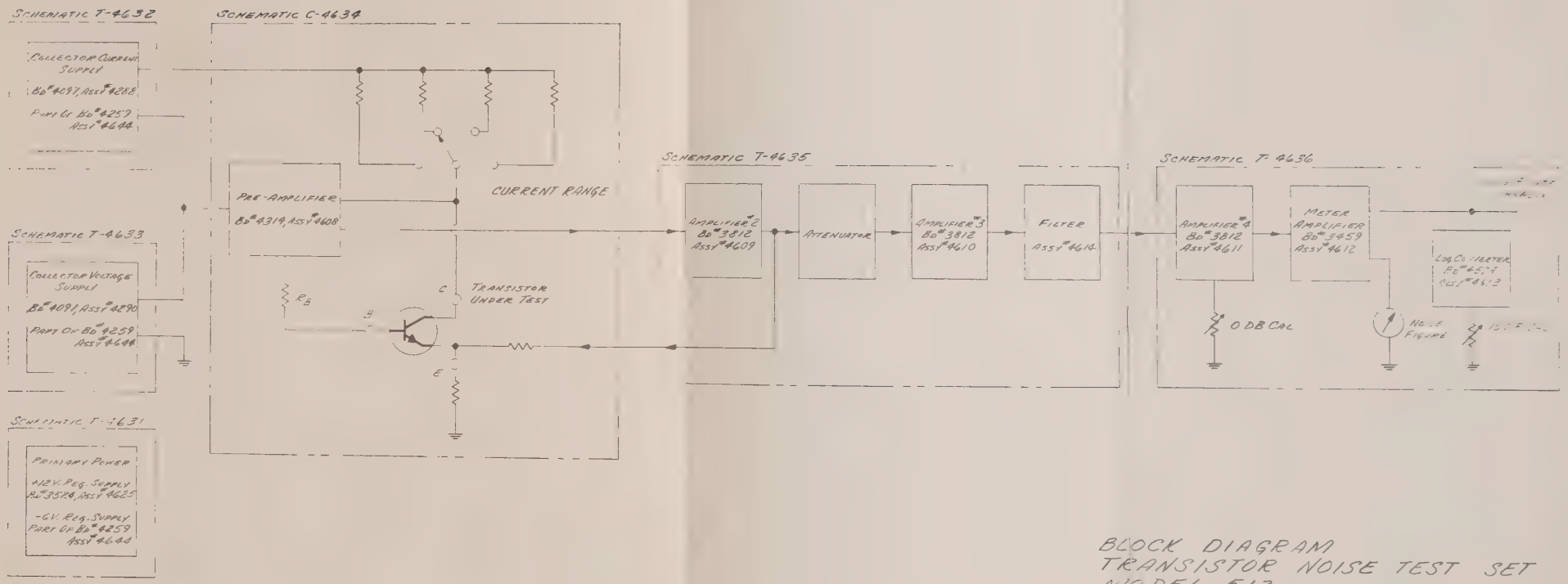
Changes and improvements in the semiconductor products available for commercial use necessitate type changes from time to time. To eliminate confusion and costly paperwork, many of these changes will be covered in the following legend. The purpose of this legend is to acknowledge the fact that the type number on a semiconductor found in a piece of equipment will not necessarily correspond with the type number given on the schematic diagram.

The legend is not intended to be an interchangeability list although in many cases good quality components* within a given category may be substituted with acceptable results. Normally, replacements should be made using components having the same type number as the component being replaced.

Those components bearing an asterisk on the schematic diagram are factory selected components and should be obtained from Quan-Tech Laboratories.

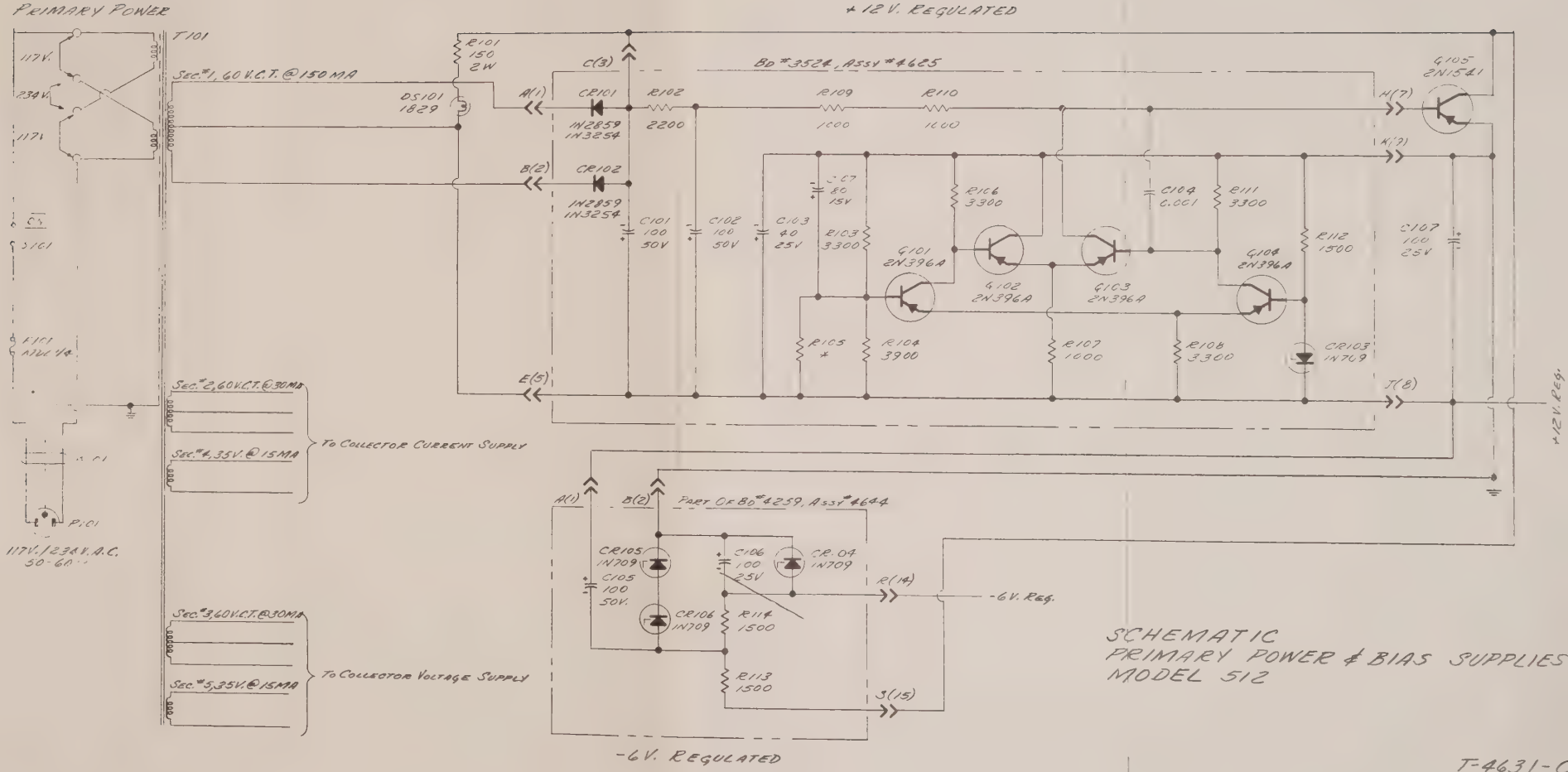
*It should be noted that the incoming inspection procedure followed at Quan-Tech Laboratories includes noise screening on most semiconductors.

| TYPE # ON SCHEMATIC | TYPE # IN EQUIPMENT |
|---|---|
| 2N414 | 2N396A, 4JX1G759, 4JX1D653 |
| 2N396A | 4JX1G759, 4JX1D653 |
| T1480 | 2N1613 |
| T1494 | 2N1613 |
| 2N2603 | 2N3250 |
| 2N929 | 220N2 |
| 2N2219 | 220N2 |
| 1N2859 | 1N3253, 1N3254 |
| 1N2862 | 1N3254 |
| 1N709 | 1N753 |



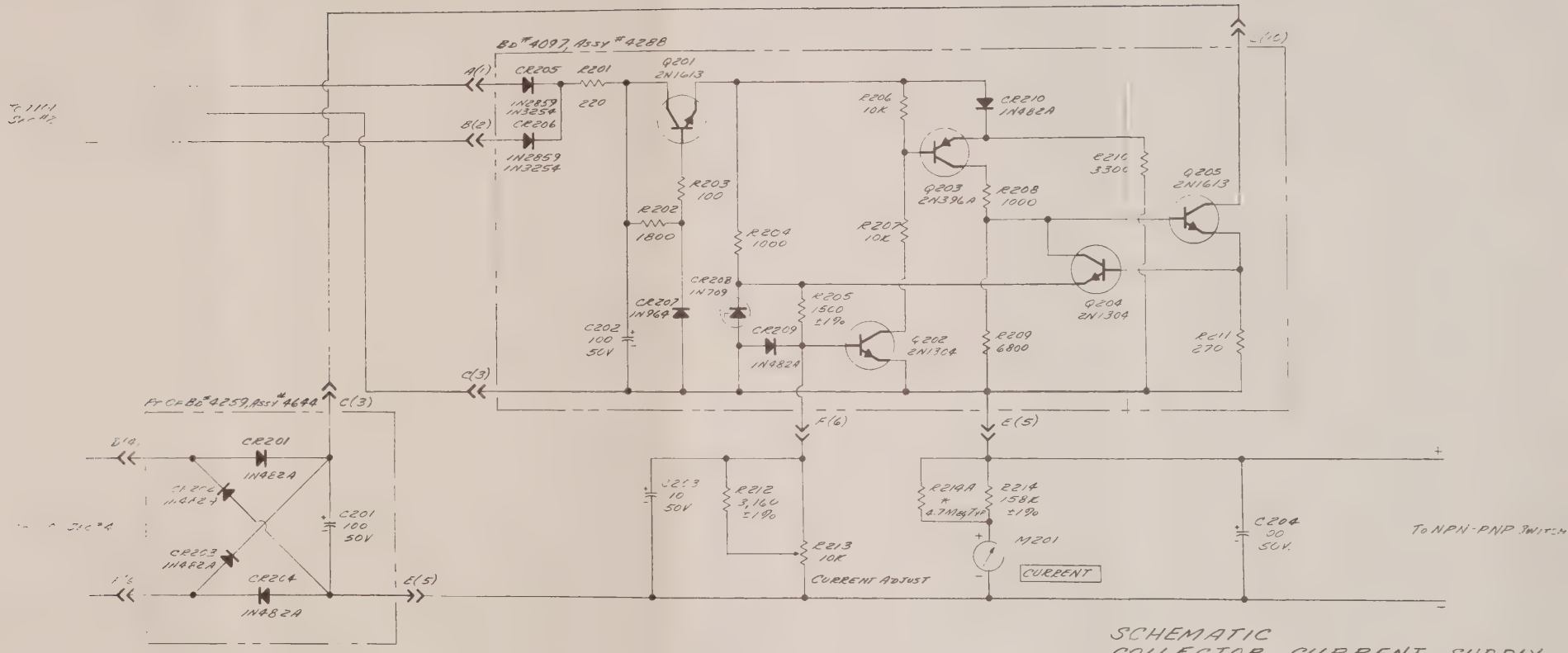

BLOCK DIAGRAM
TRANSISTOR NOISE TEST SET
MODEL 512

T-4630-A



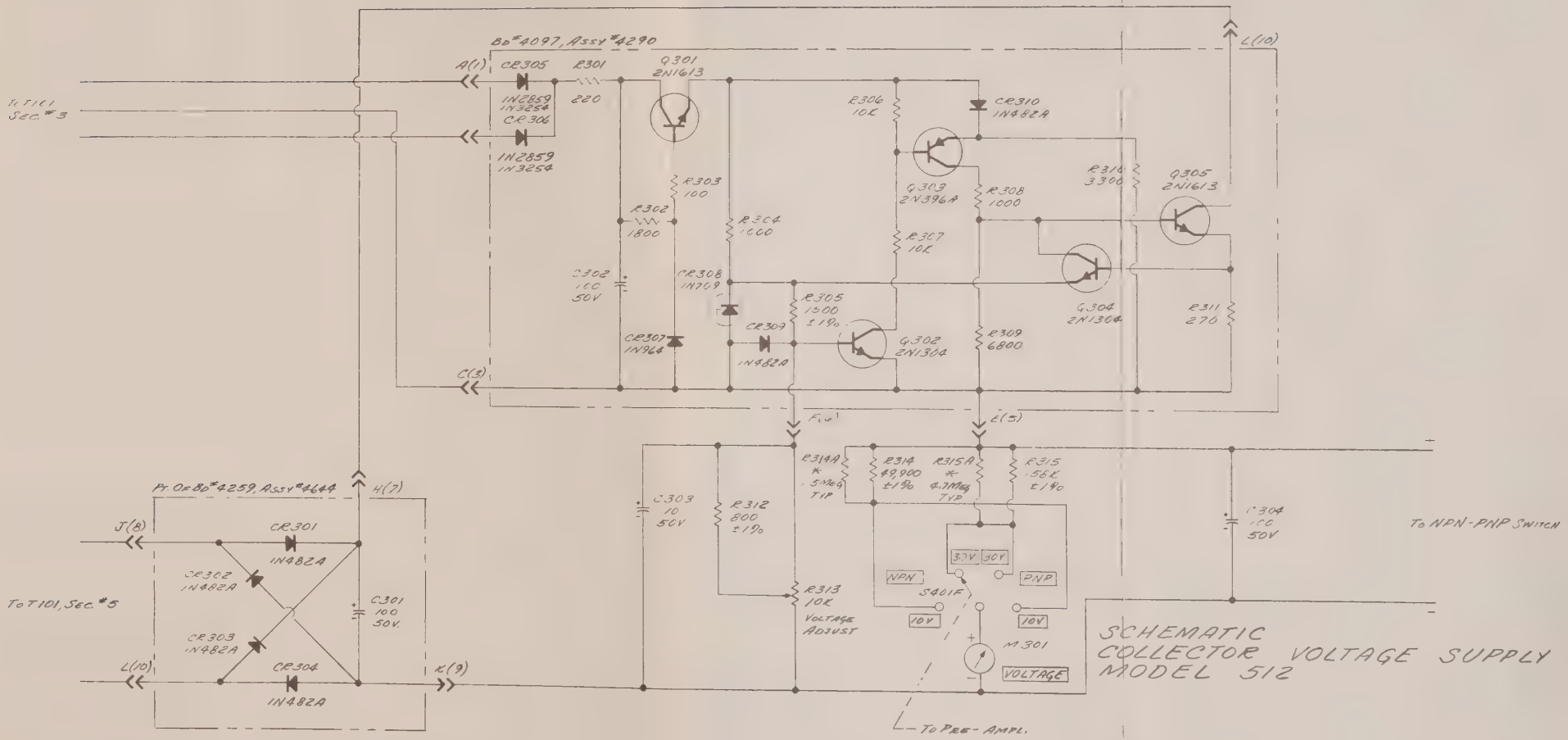

SCHEMATIC
PRIMARY POWER & BIAS SUPPLIES
MODEL 512

T-4631-C



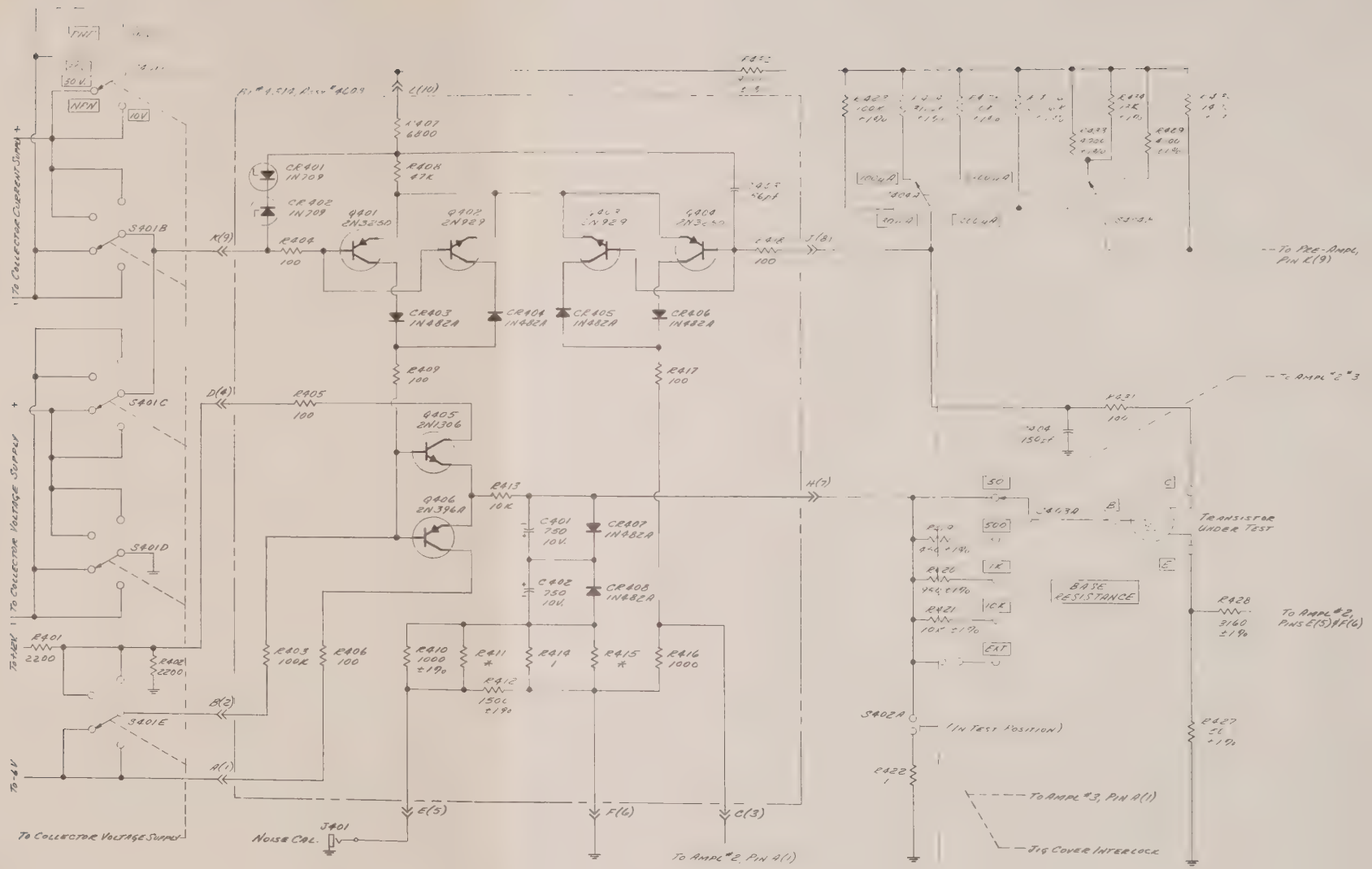

SCHEMATIC
COLLECTOR CURRENT SUPPLY
MODEL 512

T-4632-C



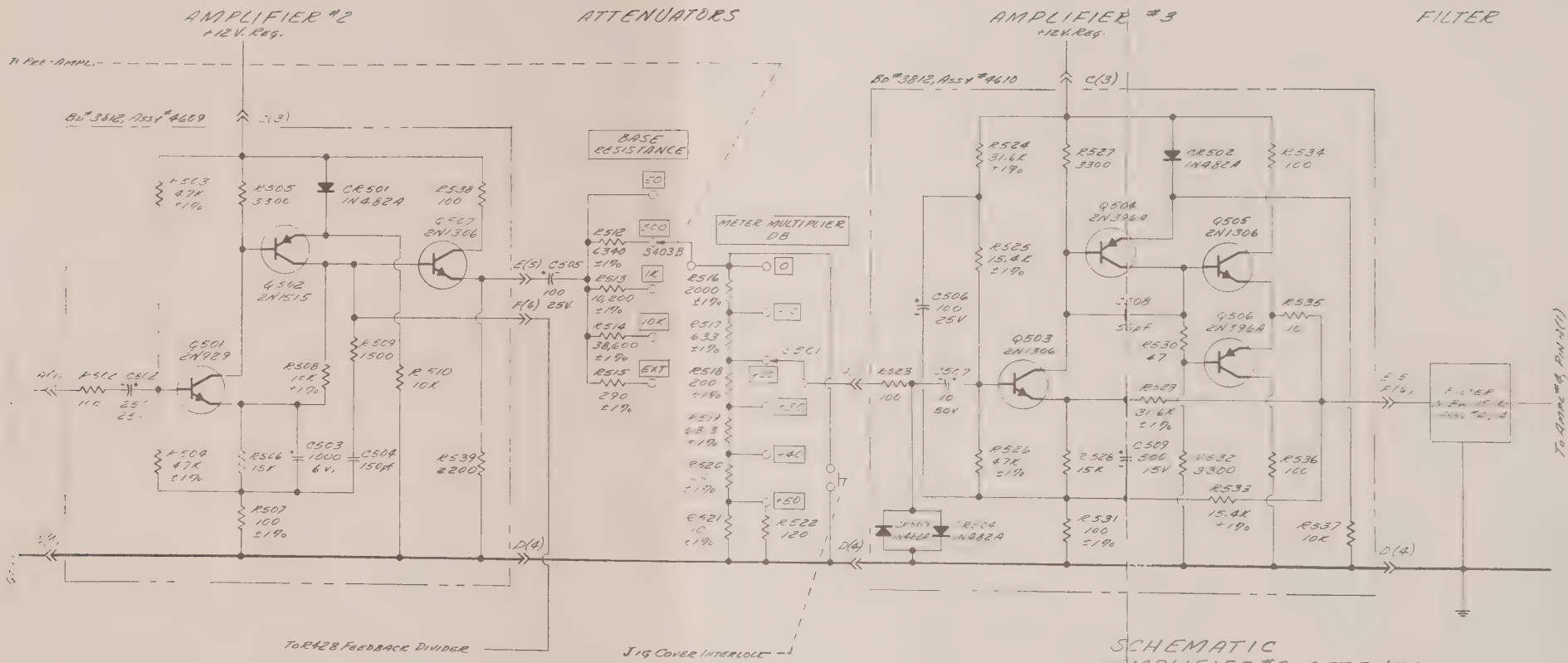

SCHEMATIC
COLLECTOR VOLTAGE SUPPLY
MODEL 512

T-4633-C



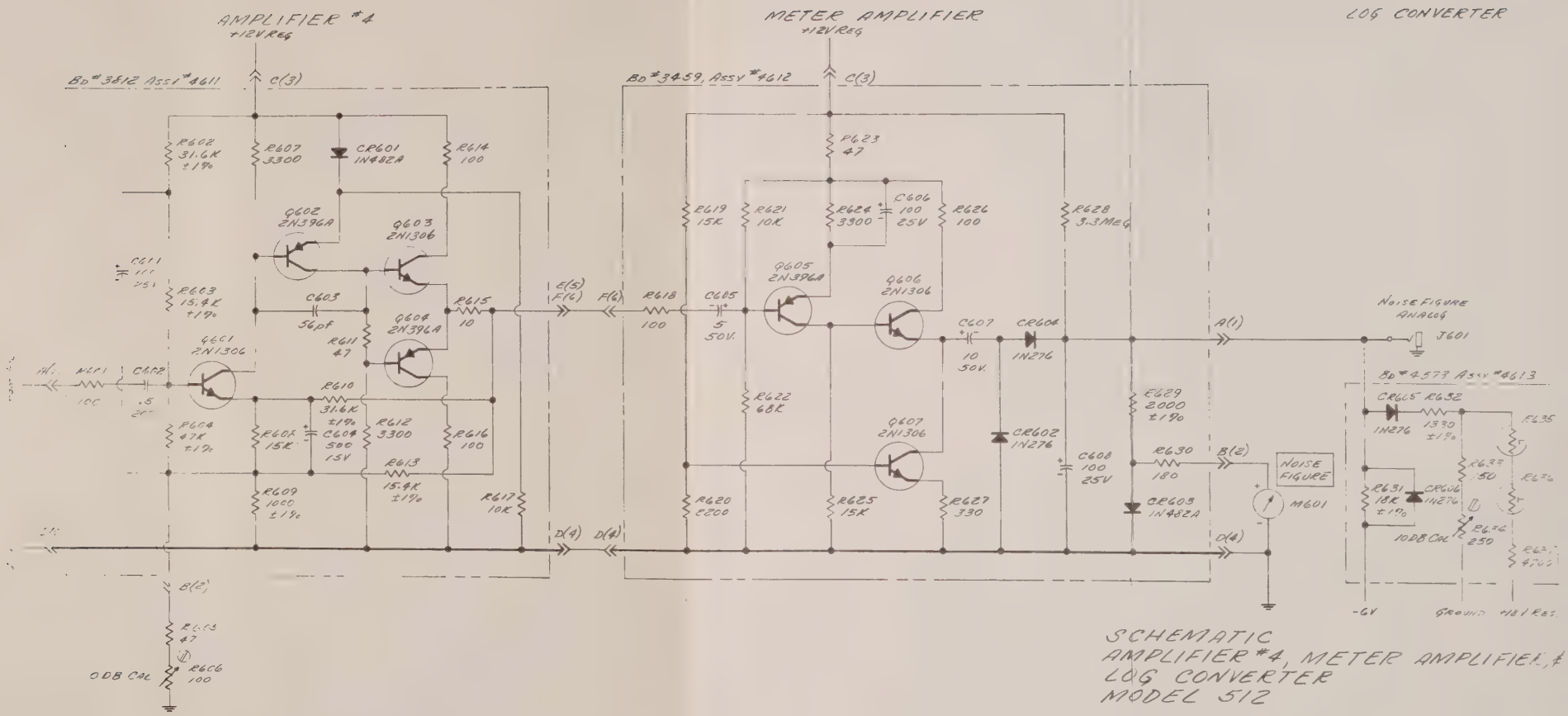

SCHEMATIC
PRE-AMPLIFIER
MODEL 512

C-4634-B




SCHEMATIC
AMPLIFIER #2, ATTENUATORS,
AMPLIFIER #3, & FILTER
MODEL 512

T-4635-B




SCHEMATIC
AMPLIFIER #4, METER AMPLIFIER, &
LOG CONVERTER
MODEL 512

T-4636-B

# Short Form Catalog

INSTRUMENTS • AMPLIFIERS • NOISE INSTRUMENTATION

# Quan-Tech® GENERAL INSTRUMENTS

• ELECTRONIC INSTRUMENTS • ANALYZERS • AMPLIFIERS • SPECIAL INSTRUMENTS •

## WAVE ANALYZERS

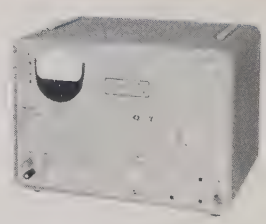
### MODEL 303
### WAVE AND NOISE SPECTRUM ANALYZER

**Frequency range:** 30 cps to 100 Kc. **Bandpasses:** 10, 30, 100, 1000 cps, selectable at front panel. (100 and 1000 cps bandwidths flat-topped for simplified noise computation, greater accuracy and convenient tuning. **Sensitivity:** 100 $\mu$v to 300 v, FS. Down to 1 $\mu$v FS with accessory Model 203 preamplifier (see below). ±300 cps vernier; selection of long or short meter time constants; metering circuits compensated to minimize error from instantaneous noise pulses; overload-protected meter; analog output for external monitoring. **Price:** $1475

### MODEL 2156 WAVE AND SPECTRUM ANALYZER

Similar to above except: **Frequency range:** 10 cps to 30 Kc. **Bandpasses:** 3, 10, 30, 300 cps. **Price** $1950

### MODEL 304
### LOW FREQUENCY WAVE & SPECTRUM ANALYZER



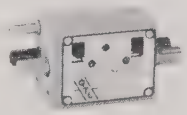
**Frequency range:** 1 cps to 5 Kc; **Bandpasses:** 1, 10 & 100 cps, selectable at front panel; **Skirt Selectivity:** 24 DB per 1/2 bandwidth; **Voltage range:** 30 $\mu$V to 100 v, FS; down to 3 $\mu$V FS with accessory Model 201B preamplifier (see below); **Tuning:** Manual or automatic; Internally supplied electronic sweep of total frequency range or of any portion; provision for external sweep; **Frequency Calibration:** Linear; **Outputs:** BFO, sample of automatic sweep, analogs of meter readings and frequency setting, phase output for phase plot on X-Y recorder. **Price:** $2350

### OPTIONAL FEATURES

Pen lift; AFC; Log, squared, or RMS meter reading; slave operation for multi-channel analyzer system. Prices: Upon request.

## SOLID STATE AMPLIFIERS

### MODEL 201B
### DC DECADE AMPLIFIER
### AC OR DC COUPLED



**Bandwidth:** DC or 10 cps to 3Mc (3db); **Gain:** 10 (fixed); Power: Self-contained batteries: 600 hour life. **Price:** $110

### MODEL 203
### LOW NOISE AC AMPLIFIER

**Bandwidth:** 30 cps to 100 Kc (±0.5 db); —3 db at 500 Kc; **Gain:** 100 (fixed); **Typical noise:** $5 \times 10^{-9}$ v and $3 \times 10^{-12}$ a per root cycle at 1 Kc. Battery powered; **Price:** $125

### MODEL 205
### HIGH-STABILITY DC AMPLIFIER

**Bandwidth:** dc to 100 Kc (0.5 db down); 3 db down at approx. 500 Kc; **Gain:** 10 (fixed); **Typical drift:** less than 250 $\mu$v at constant ambient, input shorted. External + & — 12 v required. **Price:** $105

### MODEL 206
### SELECTABLE GAIN AC AMPLIFIER

**Bandwidth:** 10 cps to 100 kc (within 0.5db); —3db at 500 Kc. **Typical noise:** $5 \times 10^{-9}$ v and $3 \times 10^{-12}$ a per root cycle at 1 Kc. **Gain:** 10, 100 & 1000, selectable at front panel; **Power:** 105-125 v AC or optional self-contained battery pack (automatically recharging). **Price:** $165, Batteries $25.

### MODELS 2182 AND 2220
### AC INSTRUMENTATION AMPLIFIERS

Modular rack mounted amplifiers having controlled gain vs frequency characteristics. **Max voltage gain:** 10,000. **Attenuation:** 0-75 db in 5 db steps. **Frequency characteristics:** (selected by plug-in cards) voltage gain flat 10 cps to 100 Kc or 10 cps to 20 Kc, rising 3 db/octave 10 cps to 100 Kc or 6 db/octave 10 cps to 20 Kc. **Power:** 105-125 VAC.

**MODEL 2182** (shown) mounts four units in a 7" x 19" rack panel. **Price** $455.

**MODEL 2220** (not metered) mounts eight units in 7" x 19" rack panel. **Price** $590.

### SPECIAL INSTRUMENTS

Quan-Tech manufactures a great many "specials", ranging from one unit only to production quantities on an OEM basis. Our engineering department is extremely flexible and equipped to handle anything from minor modifications of standard instruments to the design and construction of an extremely complicated fully automatic noise measuring system. We are proud of our ability to meet difficult specifications that challenge the state of the art for low noise, stability, and accuracy. Your inquiry will receive a prompt reply.

All prices shown are F.O.B. Whippany, N. J. Prices and specifications subject to change without notice.


# Quan-Tech LABORATORIES, INC.

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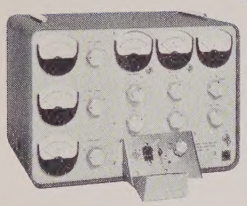
# Quan-Tech®

## NOISE INSTRUMENTS



### MODEL 310 TRANSISTOR NOISE ANALYZER

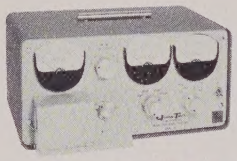
Measures noise current and voltage at 100 cps, 1 Kc and 10 Kc, as well as $I_{ebo}$, $I_{cbo}$, and beta. **Noise voltage range:** 0.01 to 3 $\mu$V/root cycle, FS. **Noise current range:** 1 to 300 pa/root cycle, FS. **Collector current range:** 0.05 to 30 ma. **Collector voltage range:** 0.1 to 30 v. **Base resistance range:** 0, 500, 1K, 10K plus external position. **Price:** $2375

### MODEL 311 TRANSISTOR NOISE ANALYZER

Similar to above, except that collector current range is from 5 to 1000 $\mu$a for noise measurement in low-collector-current devices. Measures Gm instead of beta. Also measures FET's. **Price:** $2575

### MODEL 312 TRANSISTOR NOISE ANALYZER

Similar to Model 310, but designed for measurement of field-effect transistors. **Drain voltage range:** 0.1 to 30 v. **Drain current range:** 0.05 to 30 ma. **Gate Bias range:** 1 v forward to 15 v reverse, continuously adjustable. Also measures transconductance. **Price:** $2575.



### MODEL 510 TRANSISTOR NOISE ANALYZER

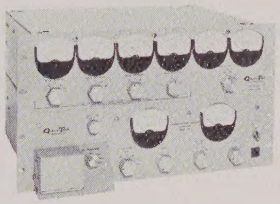
Similar to Model 310 except that it measures noise current and voltage at 1 Kc only. No beta or leakage measurements. **Noise voltage range:** 0.01 to 3 $\mu$V/root cycle FS. **Noise current range:** 1 to 300 pa/root cycle FS. **Collector voltage range:** 3 to 30v. **Collector current range:** 0.1 to 10 ma. **Base resistance range:** 0, 500, 1K, 10K ohms plus external position. Also measures FET's. **Price:** $1095.

### MODEL 511 TRANSISTOR NOISE ANALYZER

Identical with Model 510 except **Collector current range:** 3 to 300 $\mu$a. **Price:** $1145.

### MODEL 512 TRANSISTOR NOISE ANALYZER

Similar to Model 510 except that it measures broadband (10 cps to 15.7 Kc) noise figure. **Collector current range:** 10 $\mu$a to 1 ma. **Price:** $1145.



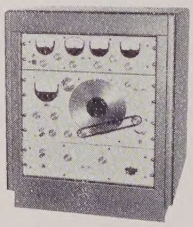
### MODEL 2173-2181 TRANSISTOR NOISE ANALYZER

The most versatile unit available. Measures noise current and voltage at 10 and 100 cps, 1, 10, and 100 Kc simultaneously. **Noise voltage range:** 3 to 3000 nanovolts/root cycle FS. **Base resistance range:** 0, 500, 1K, 10K, 100K, and 1M ohms plus external position. **Collector voltage range:** 0.3 to 60 volts. **Collector current range:** 0.3 $\mu$a to 30 ma. Also measures FET's. **Price:** $4950.

### VERY LOW FREQUENCY NOISE ANALYZER

On special order we can supply a test jig and preamplifier for use with the Model 304 Low Frequency Wave and Spectrum Analyzer for making noise measurements at frequencies down to 1 cps. Write us outlining your requirements.

### MODEL 2158 NOISE ANALYSIS SYSTEM



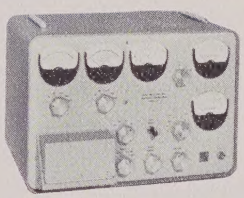
Measures noise in any component or system from 30 cps to 100 Kc. Consists of Model 303 Wave Analyzer with motor driven sweep, two preamplifiers, and two metered power supplies. **Preamplifier gain:** 10, 100, 1K, and 10K. **Input impedance:** 100K + 50 pf or 10 meg + 50 pf. **Typical input noise:** 4 x $10^{-9}$ V and 2 x $10^{-12}$ A (100K input), 8 x $10^{-9}$ V and 6 x $10^{-14}$ A (10 meg input), per root cycle at 1 Kc. **Power Supplies:** 0.1 to 30 volts and 1 to 450 volts at 100 ma. each. Overload protected. **Ripple:** 1 microvolt max. **Price:** $5200.

### MODEL 315 RESISTOR NOISE TEST SET

Measures noise in resistors in conformance with specifications recommended by NBS and Method 308 of MIL STD 202B. **Test-resistor range:** 100Ω to 22 meg Ω. **Measurement range:** 0.6 $\mu$V in a decade to 1000 $\mu$V in a decade. **Outputs:** Sample of noise voltage; analogs of meter readings. External cable supplied for remote location of test jig. **Price:** $1950

### MODEL 2136

Similar to above, but measures resistors down to 10 Ω. **Price:** $2300



### MODEL 327 DIODE NOISE ANALYZER

Measures noise in back-biased semi-conductor diodes at 10 cps and 1 Kc simultaneously. **Noise voltage range:** 0.03 $\mu$v to 1 mv/cycle of bandwidth. **Test voltage:** 0 to 500v, continuously variable. **Test current:** 0 to 100 ma, continuously variable. Internally supplied ramp automatically sweeps test current and/or voltage within maximum ratings. A wide variety of outputs for data logging, external monitoring, actuating external equipment, etc. **Price:** $2750

### TEST JIG AND TRANSFORMER

For measuring noise in forward-biased diodes up to 100 ma. **Price:** $300.

### MODEL 317 AMPLITUDE DISTRIBUTION ANALYZER

Determines amplitude - probability distribution of random signals. **Amplifier response:** 3 db down at approx. 12 cps and 1 Mc; **Switching rate:** 5 Mc; **Amplitude ranges:** 100%, 10%, 1% FS; Normal or "inverted" operation; provision for external sweep of level. **Price:** $450

### MODEL 420 RANDOM NOISE GENERATOR

Stable "white" noise output having true gaussian amplitude distribution. **Frequency range:** dc to 100 Kc; **Output voltage:** 0.01 to 1000 $\mu$v/root cycle, continuously variable, calibrated; **DC offset:** less than 10 mv at max. output. **Price:** $525

### MODEL 2184 DIGITAL RESISTOR NOISE TEST SYSTEM

Digitizes, stores, and presents resistor noise data. Consists of Model 2136 Resistor-Noise Test Set plus three digital voltmeters, storage, timing circuits, and optical and punch-card readout. Automatic sequence converts, sums, and stores five total noise readings, five system noise readings, and applied DC voltage. Presents three data channels simultaneously to punch-card system, plus selectable optical readout of any channel. All digital circuitry designed and built by Quan-Tech. **Price:** $9500.

### MODEL 2170-71-72 AUTOMATIC RESISTOR NOISE TEST SYSTEM

High-speed automatic sorting of resistors by Noise Index. Sorts 3000/hr. at ± 1 db tolerance, 6000/hr. at ± 3 db tolerance. Higher speeds obtainable by adding additional channels. **Price:** $12,900. (less mechanical handling)

The above systems and modifications of them can be adapted to measuring noise in transistors and diodes. Write us outlining your requirements.

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# A Word About Noise Analysis

Since 1957 when it was founded, Quan-Tech Laboratories has specialized in the amplification and measurement of extremely low level signals approaching the theoretical limits of sensitivity. In order to build equipment of this sort it was necessary to select components having the lowest possible electrical noise for use in the most sensitive parts of the circuit. Noisier components were relegated to places where (it was thought) their noise would not interfere with proper operation. These noisy components exhibited a very high rate of failure compared to the quiet ones, so an intensive study of the reasons for these failures was undertaken.

Investigation showed that those components which exhibited excessive amounts of noise (particularly of the "1/f" type) compared to similar units, usually contained some defect or abnormality which could lead to early failure. This was equally true of resistors, transistors, and diodes, even though the failure mechanism might be different for each device.

This discovery led to the development of specific electrical noise measuring instruments for each type of component. Cooperative programs with manufacturers have proved beyond doubt that noise measurements, properly applied, can locate many types of failure-prone components before they are placed in the circuit, with resultant cost saving and increased reliability. Even manufacturers of such fiercely competitive items as automobile radios, electronic organs, and hearing aids have found noise screening cuts costs and improves product quality.

If you haven't already investigated the benefits of noise analysis, both for reliability and for very low noise applications, why not contact us or our local representative and get the full story?

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